CLAIMS

What is claimed is:

1. A method for combining a first imaging mode and a second imaging mode to generate a combined ultrasound image, the method comprising:

(a) generating transmit pulses at a predetermined voltage level for the first imaging mode;

(b) acquiring a first image in the first imaging mode in response to the transmit pulses generated in act (a);

(c) generating transmit pulses at the predetermined voltage level for the second imaging mode, with a duty cycle selected in response to one or more of: a restriction on surface temperature of a transducer, and a restriction on transducer power output;

(d) acquiring a second image in the second imaging mode in response to the transmit pulses generated in act (c); and

(e) displaying the first and second images.

2. The method of claim 1, where said generating transmit pulses at the predetermined voltage level for the first imaging mode comprises on-off switching of a single DC voltage supply.

3. The method of claim 1, where the first imaging mode is a B-mode ultrasound imaging mode.

4. The method of claim 1, where the second imaging mode is a Doppler-spectral ultrasound imaging mode.

5. The method of claim 1, where the second imaging mode is a color-mode ultrasound imaging mode.

6. The method of claim 1, where acts (a)-(e) are repeated to generate an interleaved sequence of first and second images.

7. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit of 43° C.

8. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit of 41° C.

9. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit of 50° C.

10. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit in the range of 38° C to 40° C.

11. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit in the range of 35° C to 38° C.

12. The method of claim 1, where the duty cycle is selected to meet a maximum transducer surface temperature limit specified by International Standard IEC 60601-2-37.

13. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output of 720 mW/cm^2.

14. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output in the range of 550 to 600 mW/cm^2.

15. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output in the range of 575 to 650 mW/cm^2.

16. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output in the range of 550 to 700 mW/cm^2.

17. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output of 50 mW/cm^2.

18. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output in the range of 45 to 48 mW/cm^2.

19. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output in the range of 44 to 46 mW/cm^2.

20. The method of claim 1, where the duty cycle is selected to meet a maximum transducer power output specified by "Information for manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers."

21. The method of claim 1, where act (a) includes transmitting a train of unipolar pulses.

22. The method of claim 1, where act (a) includes transmitting a train of bipolar pulses.

23. The method of claim 1, where act (a) comprises

(a1) setting a voltage supply to the predetermined voltage level; and

(a2) using one or more switches to engage or disengage the voltage supply.

24. The method of claim 1, where the predetermined voltage level is a user-selectable voltage level.

25. The method of claim 1, where the predetermined voltage level is selected in response to one or more of: the restriction on surface temperature of the transducer, and the restriction on transducer power output.

26. The method of claim 1, where the predetermined voltage level is selected to meet a maximum transducer surface temperature limit of 43° C.

27. The method of claim 1, where the predetermined voltage level is selected to meet a maximum transducer power output in the range of 550 to 600 mW/cm^2.

28. A transmit method for ultrasound imaging, the method comprising:

(a) generating a first pulse train for a first mode of operation at a fixed voltage level selected in response to a restriction on surface temperature of a transducer;

(b) applying the first pulse train to a transducer;

(c) generating a second pulse train for a second mode of operation substantially at the fixed voltage level, wherein the second mode of operation is different from the first mode of operation;

(d) applying the second pulse train to the transducer.

29. The method of claim 28 wherein act (c) comprises generating the second pulse train with pulses having a duty cycle chosen in response to the restriction on surface temperature of the transducer.

30. The method of claim 28 wherein the first pulse train is a B-mode pulse train.

31. The method of claim 28 wherein the second pulse train is a color-mode pulse train.

32. The method of claim 28 wherein the first pulse train is a B-mode pulse train and the second pulse train is one of: a color-mode pulse train and a spectral Doppler-mode pulse train.

33. The method of claim 28 wherein the first and second pulse trains are unipolar pulse trains.

34. The method of claim 28 wherein the first and second pulse trains are bipolar pulse trains.

35. The method of claim 28 wherein the first pulse train includes at least one transmit cycle and wherein the second pulse train includes at least four transmit cycles.

36. The method of claim 28 wherein the first pulse train includes at least two transmit cycles and wherein the second pulse train includes at least four transmit cycles.

37. The method of claim 28 wherein the first pulse train is a B-mode pulse train that includes at least two transmit cycles, and wherein the second pulse train is a color-mode pulse train that includes at least four transmit cycles.

38. The method of claim 28, further comprising:

(e) detecting a received pulse train from the transducer;

(f) filtering the received pulse train with a lower center frequency than a center frequency of the transmit pulse train.

39. An ultrasound transmitter comprising:

a pulse train generator operable to generate a first pulse train for a first mode of operation and a second pulse train for a second mode of operation;

wherein the second mode of operation is different from the first mode of operation;

a transducer coupled to the pulse train generator; and

a power supply coupled to the transducer and operable to supply a fixed voltage level to the transducer for both the first and second pulse trains;

where the fixed voltage level is selected in response to one or more of: a restriction on surface temperature of the transducer, and a restriction on transducer power output.

40. The transmitter of claim 39, where the second mode of operation is configured to transmit pulses with a duty cycle, where the duty cycle is selected in response to one or more of: the restriction on surface temperature of the transducer, and the restriction on transducer power output.

41. The transmitter of claim 39 wherein the pulse train generator comprises a bipolar pulse train generator.

42. The transmitter of claim 39 wherein the first pulse train is a B-mode pulse train and the second pulse train is a color-mode pulse train.

43. The transmitter of claim 39 wherein the first pulse train is a B-mode pulse train and the second pulse train is a spectral Doppler-mode pulse train.

44. The transmitter of claim 39 wherein the first pulse train includes at least one transmit cycle and wherein the second pulse train includes at least four transmit cycles.

45. The transmitter of claim 39 wherein the first pulse train includes at least two transmit cycles and wherein the second pulse train includes at least four transmit cycles.

46. An ultrasound transmitter comprising:

a number Np of fixed-voltage power sources;

a pulse train generator coupled to the number of fixed-voltage supplies;

wherein the pulse train generator is operable to generate pulse trains for a number Nm of operating modes, and wherein the number of operating modes include at least two of: B-mode operation, color-mode operation, and spectral Doppler-mode operation;

wherein at least one of the operating modes has a pulse profile with a duty cycle selected in response to one or more of: a restriction on surface temperature of the transducer, and a restriction on transducer power output.;

wherein the number Nm of operating modes is greater than the number Np of fixed-voltage power sources.

47. The transmitter of claim 46 wherein the pulse train generator comprises a bipolar pulse train generator.

48. A computer-readable medium for generating a combined ultrasound image with a first imaging mode and a second imaging mode, the computer-readable medium comprising a data storage device and computer-executable program code stored on the data storage device, where the computer-executable program code comprises:

(a) code for generating transmit pulses at a predetermined voltage level for the first imaging mode;

(b) code for acquiring a first image in the first imaging mode in response to the transmit pulses generated by the code in (a);

(c) code for generating transmit pulses at the predetermined voltage level for the second imaging mode, with a duty cycle selected in response to one or more of: a restriction on surface temperature of a transducer, and a restriction on transducer power output;

(d) code for acquiring a second image in the second imaging mode in response to the transmit pulses generated by the code in (c); and

(e) code for displaying the first and second images.

49. The computer-readable medium of claim 48, where the code for generating transmit pulses at the predetermined voltage level for the first imaging mode comprises code for an on-off switching of a single DC voltage supply.

50. The computer-readable medium of claim 48, where the first imaging mode is a B-mode ultrasound imaging mode.

51. The computer-readable medium of claim 48, where the second imaging mode is a Doppler-spectral ultrasound imaging mode.

52. The computer-readable medium of claim 48, where the second imaging mode is a color-mode ultrasound imaging mode.

53. The computer-readable medium of claim 48, further comprising code for repeating the code in (a)-(e) to generate an interleaved sequence of first and second images.

54. The computer-readable medium of claim 48, where the duty cycle is selected to meet a maximum transducer surface temperature limit of 43° C.

55. The computer-readable medium of claim 48, where the duty cycle is selected to meet a maximum transducer power output of 720 mW/cm^2.

56. The computer-readable medium of claim 48, where the code in (a) includes code for transmitting a train of bipolar pulses.

57. The computer-readable medium of claim 48, where the code in (a) comprises

(a1) code for setting a voltage supply to the predetermined voltage level; and

(a2) code for using one or more switches to engage or disengage the voltage supply.

58. The computer-readable medium of claim 48, where the predetermined voltage level is a user-selectable voltage level.

59. The computer-readable medium of claim 48, where the predetermined voltage level is selected in response to one or more of: the restriction on surface temperature of the transducer, and the restriction on transducer power output.